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# **PRIVACY ISSUES (RFID)**

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## **Project Proposal**

My term project will be connected to privacy concerns. The focus of my effort will be centered on Radio Frequency Identification Tags, otherwise known as RFID tags. I chose RFID tags because this technology has been around since the mid 1990's but lately the use of them has skyrocketed. It's the common story of many people often use them but have no idea that they do. These tags offer endless possibilities for the future and already impact daily life quite a bit, but there is a great concern with privacy. Many of these RFID tags hold private, personal information and some even contain financial data on them. Many are calling Radio Frequency Identification Tags "the mark of the beast" due to the risk of identity theft and a host of other concerns.

I envision this project will offer some awareness on the privacy concerns and also some comfort in the protection against those issues. I am also very excited to look into how other are using RFID tags and speak on some future possibilities for them.

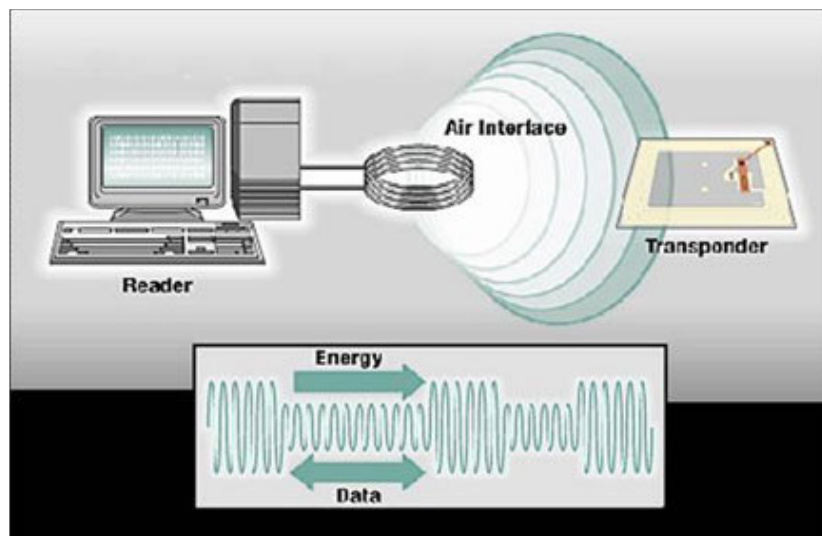
## **History of RFID Tags**

It is believed that the discovery of Radio Frequency Identification goes back to World War II. Americans, Japanese, Germans, and the British all were using radar to warn of approaching planes. The issue was that they could not distinguish between friendly and enemy aircraft. The Germans then discovered that if their pilots rolled their planes when returning to base, it would change the frequency of the radio waves. This was the first passive use of Radio Frequency Identification and would indicate whether the planes were allies or foes. The first use of an active tag came when the British developed the Identify friend or foe (IFF) system. They put a transmitter inside of all British aircraft so when it received a signal from the radar stations on the ground, it would turn on and begin transmitting a friendly wave. If this friendly wave was not received from the plane it was marked as foe.

It is believed that the above uses of radio waves were discovered in the 1930s but the first patent did not come until 1973 when Mario Cardullo receive a patent for transmitting Radio Frequency through sound and light. That same year Charles Walton was granted the first patent using the abbreviation RFID. It was for a passive transponder that unlocked doors without a key. When the RFID embedded card was brought near the door, an adjacent reader would determine if the card had the correct identity number. If it did, the door would unlock.

## **What is a RFID tag?**

To begin, RFID is short for Radio Frequency Identification. This is merely a generic term for a process that uses radio waves to identify people or objects. A microchip is used to store unique information, which is usually a serial number. This microchip is attached to an antenna and this pair is what makes an RFID tag or transponder. When the reader or transponder comes within the range of a reader, the antenna enables the microchip to transmit the stored information. The reader, which is usually linked to a computer, converts these radio waves into digital information.



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There are two categories of RFID transponders, passive and active. Passive tags have no internal power supply which grants them the bequest of having indefinite life expectancy. Active tags are powered by batteries and have to have the internal power source replaced or recharged when necessary.

## **Types of RFID Tags**

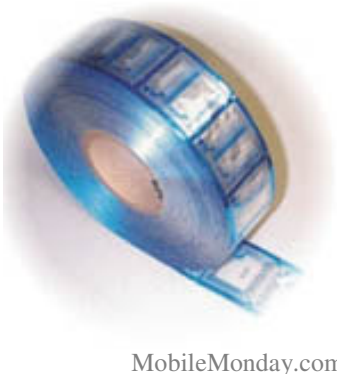
### **~ Passive (Overview)**

As it was stated earlier passive RFID tags are ones that do not have an internal power supply. In order for these chips to work, they must receive just enough power from the radio transmission. Think of them as a computer when it is not turned on. Nothing happens, but when the power button is pressed, all the internal components come to life. Passive RFID tags use the electrical current received from the transmitting antenna to power on. They then return the necessary information through a process called backscattering. This is basically when the radio waves are reflected back to the sender after absorption, almost like radar.

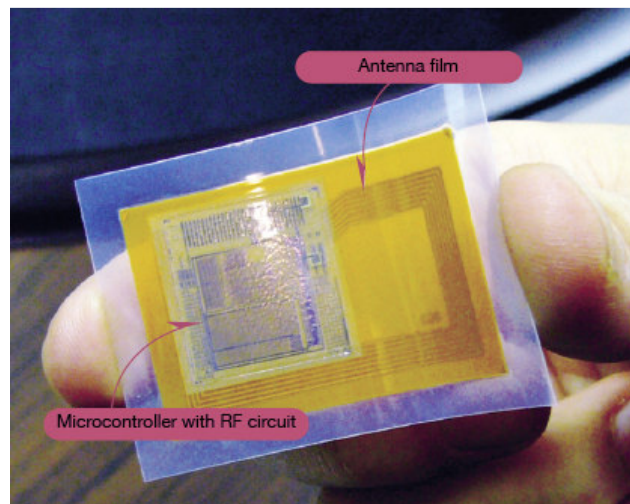
Usually when passive tags are chosen over another type, size and flexibility is a concern. Because passive tags don't require an internal power supply, their antennas must be designed to receive power from the incoming signal and transmit data via the backscattered signal. The benefit in not having this embedded battery pack is of course size. They vary widely but most passive RFID tags are small enough to be inserted under the skin or inside of a sticker. In 2006, Hitachi developed a chip that was thinner than a sheet of paper; it was about seven and a half micrometers thick. A year later they developed another similar chip that was not only thinner than a sheet of paper but could be embedded inside a sheet of paper like a watermark. This newer, thinner chip can store the same amount of information but the data can be extracted from further away, one foot compared to a couple hundred meters.

## Types of RFID Tags

Other than size, flexibility is another key deciding factor between the types of tags. The majority of passive RFID tags are now Silicon based, but currently there are several companies in a race to produce polymer semiconductors. In the near future if this polymer based semiconductor technology is commercialized, RFID tags could be roll printable like magazines. This would drop the cost per tags to almost nothing, the same way barcodes are today.



MobileMonday.com



Gizmodo.com

### ~ Passive (Advantages v. Disadvantages)

#### *Major Advantages*

- Functions without a battery, which grants an indefinite useful life
- Is much less expensive to manufacture
- Small size, which expands the application opportunities

#### *Major Disadvantages*

- Can usually only be read at short distances
- Getting the signal to power the chip can be complicated in certain applications
- Tags are still readable even after the product no longer needs tracking



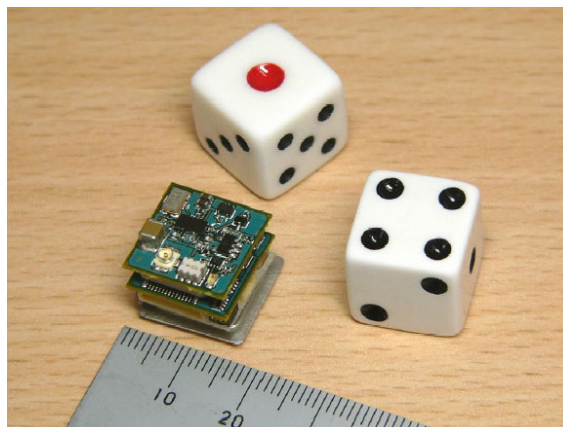
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## Types of RFID Tags

### ~ Active (Overview)

Active RFID tags, unlike passive, have an internal power supply with an active life of about 10 years. This battery is used to power all the internal circuitry used in broadcasting a signal which includes data about the product and possibly environmental information. This means that an outgoing signal is being sent. Think of active RFID tags as proactive people; instead of waiting around for things to come to them, they go out and get them. Passive RFID wait for a signal until they transmitted or backscatter data. Active RFID have a two-way 'session' with the reader.

The sent signal is much stronger than its non-active counterpart. A stronger signal extends the read range to hundreds of meters and allows for the tags to be read at greater speeds (i.e. a car traveling 100 mph). These two characteristics decrease read errors drastically, but of course these advantages come with a cost. Passive tags can be purchased for cents, while active RFID tags are still hovering around a few dollars. In optimal conditions, most would opt for passive but in "RF Challenged" environments (Water, metal compartments, etc...), active tags might be necessary.



tronweb.com

## Types of RFID Tags

### ~ Active (advantages v. disadvantages)

#### *Advantages*

- Greater read distance than passive tags
- Internal battery can power condition sensors (humidity, temp, etc...)
- Less read errors
- Can perform individual monitoring and control (compared to mass)
- Capable of diagnostics

#### *Disadvantages*

- Must have internal battery which limit the tags life
- Greater cost per tag
- Larger size
- Greater cost associate with maintaining/replacing battery
- Battery outages result in expensive misreads

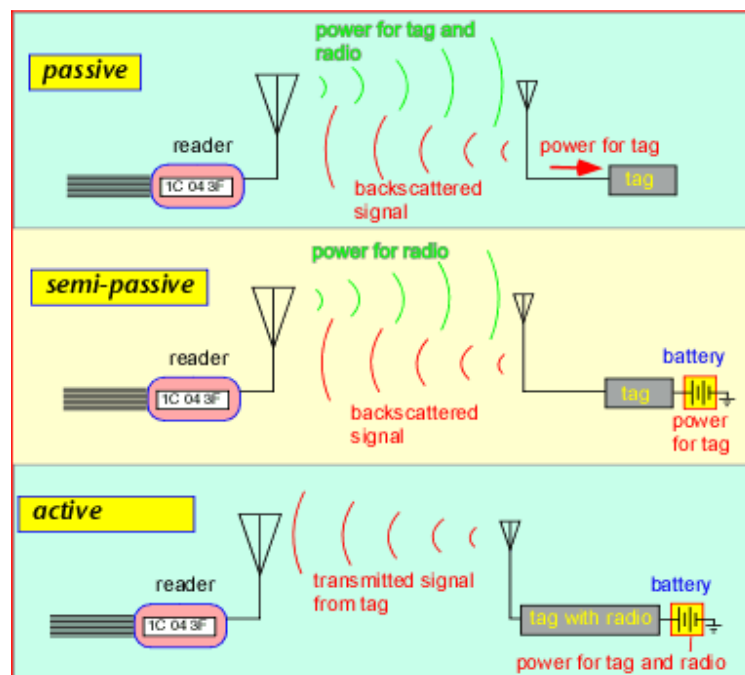
### ~ Semi-Passive (overview)

Semi-Passive tags are the great compromise between the two previous types that were discussed. These special tags act in a similar fashion to passive RFID tags in that they need the power from an incoming RF signal to transmit data. This means that unlike active tags which can initiate a transmission of data, semi-passive must wait for an incoming signal just like passive RFID tags. The difference lies in the fact that semi-passive RFID tags have an internal battery, like active RFID tags, but this battery is only used to power internal monitoring sensors and circuitry. Semi-passive tags can potentially have longer read distances than passive ones but its internal battery is not used to broadcast an RF signal like in active tags. So what possibly could be the use for a 'sometimes active' RFID tag with a battery? The answer comes by way of perishable items or sensitive goods with short shelf lives.

## Types of RFID Tags

### ~ Semi-Passive (overview continued)

When shipping or storing fresh produce, blood, organs, or certain pharmaceutical products temperature is a vital environmental characteristic that can ensure or ruin quality. It is often checked by hand or thermometers monitoring the storage area but often workers forget to check the temp of something. For example, a semi-truck carrying boxes of fresh meat arrives at a retailers warehouse. The thermometer inside of the trailer reads an optimal temp, but one of the boxes near the door was exposed to too much warm air. If the boxes are not checked individually this spoiled meat will be sold. Semi-active RFID tags with temperature sensors attached to each boxes would curtail this potentially dangerous problem. The minute the truck arrives it would be scanned and the bad box of meat would be discarded because the RFID tags would show that it has reached an unhealthy temp.



## **RFID Privacy Issues**

### **~ Human Chipping (Overview)**

For years it has been the option of pet owners to implant their pets with a tracking device. This device, in the event that the animal is lost or runs away, can be scanned by a veterinarian. The pets and owners information could then be read and the animal returned to its owner. Recently this same type of technology is being applied to humans.

‘Human Chipping’ it is commonly labeled. It is just like an RFID that is attached to a box being shipped to a store with minor differences. To keep the size to a minimum, a passive RFID is used. The microchip implant is an intergraded circuit device that is encased in a silicate glass container. Verichip Corporation was the first company to receive the daunting but necessary approval of the Food and Drug Administration (FDA). The RFID, entitled Verichip, was granted approval in 2002 and since then has been implanted in approximately 2,000 people worldwide.

The chip is about twice the size of a grain of rice and once implanted its unnoticeable. The chip itself contains no data besides a 16-digit identifier. Once scanned, this unique electronic ID is then referenced with a database to provide whatever information correlates to that ID.



Verichip Corporation

## **RFID Privacy Issues**

### **~ Human Chipping (Overview continued)**

When someone decides to be implanted or chipped, they are first administered a few local anesthetic injections. Once numb a very large syringe is used to implant the RFID. It is usually placed in the back of the upper arm, above the tricep muscle. The implant is said to be a painless outpatient procedure. The VeriChip can then be scanned when necessary by a proprietary VeriChip reader. This reader can be handheld or wall-mounted. A small amount of radio frequency passes from the reader to the dormant chip and the unique electronic ID is then sent back to the reader.

### **~ Human Chipping (Uses & Controversy)**

Hands down, the biggest use for implantable RFID chips is in the healthcare field. Everyday thousand of patients arrive at emergency rooms unable to communicate to the staff. These communication barriers can and often do lead to medical errors. VeriChip's solution to this problem is to insert selected patients with an implantable RFID chip. When these people arrive they would be scanned and the staff would reference their unique 16-digit electronic ID with a secure healthcare information database. This could either be accomplished by VeriChip's secure website or Electronic Data Interchange (EDI). EDI is a very hot topic as of late because hospitals are moving toward electronic healthcare records. According their website, VeriChip Corporation has supplied its patient identification system to 525 hospitals and over 1,300 physicians have elected to offer the solution to its patients.

## **RFID Privacy Issues**

### **~ Human Chipping (Uses & Controversy continued)**

Besides being utilized in the medical field, implantable RFIDs have other practical uses. A few years ago in Barcelona, clubs began to offer a RFID implant to its VIP members. The Baja Beach Club staffs a nurse to do the implant. If VIP's elect to do the procedure, they are implanted inside the club that night and their unique identifier is used as a method of payment. The club owner describes the chip as an in-house credit card, similar to starting a tab at the bar which is rectified before you depart.

Many companies in the United States are looking into using these implantable RFID chips as a security device. Currently, most buildings that have relatively up-to-date security systems use ID tags that are scanned to permit entry. The same principle would go for the RFID chips. Workers would be implanted and the 16-digit identifier would be used as a code to allow entry in to secure areas like data-centers or storage rooms. This practice is already being faced with strong opposition. In May of 2006, Wisconsin's governor signed a law making it illegal to require an individual to be implanted with a microchip. Soon many states will follow but other companies have found a way around this legislation, voluntary consent.

American Express has announced plans for a people tracking credit card. The card would have a small RFID chip attached to it and certain stores would have readers to sense the chip. The readers could be place anywhere like near certain racks of clothes, certain stores, or other public places.

## RFID Privacy Issues

### ~ Human Chipping (Uses & Controversy continued)

This technology could prove promising for parents keeping up with their children's movements, but no adult wants all of their whereabouts tracked. American Express met with Consumers Against Supermarket Privacy Invasion and Numbering (CASPIAN) to discuss this issue. The outcome was that customers would have to consent to the 'bugged' credit card and they would also have the option of a chip-less version.

It seems as if there is much good to develop from implantable RFID chips but the privacy risks are very high. It would be great to be implanted with an RFID incase of an emergency or to go to McDonalds and pay by waving my arm at the register but looking at it practically, this screams identity theft. The VeriChip Corporation says much of the identity theft problem is mitigated because the implanted chip only holds a numerical representation of your information. In order for someone to actually see the information in text form, they much have secure access to the database in which it is stored. This lessens the risk of hackers altering your medical records but what happens when the chip is being used for payment or security access?

This is when it becomes a serious problem because instructions for cloning a VeriChip are published on the web currently and it doesn't seem that difficult.



cq.cx.verichip.com

## **RFID Privacy Issues**

### **~ Human Chipping (Uses & Controversy continued)**

Then there is also the issue of RFIDs being implanted into US Passports. This is the biggest issue that everyone should be worried about. This chip holds very personal information and if stolen could very possible ruin ones life. In a video created by CompEx Inc., Transportation Security Administration (TSA) employees demonstrate how people could be tracked without their knowledge. In the video, an animated traveler is tracked from the minute he enters the airport via his credit card. After checking in, he receives his boarding pass which has another RFID attached to it. As he passes from point to point, RFID readers track his movements. While at the gate, a TSA employee came by with a handheld reader and scanned the room. As stated earlier, this technology seems promising but what stops someone from reading these multiple RFID chips that are on your person and gathering your personal information, passports especially.

### **~ Security Issues**

For a long time most thought it was impossible for an RFID to be infected with a virus due to its limited memory. Security experts only theorized that RFID technology would be a target for hackers, but up until now it has only been theory. In a paper titled, "Is Your Cat Infected with a Computer Virus?" details are given how exactly a virus could disseminate in an RFID system. The paper explains that a pet owner could write malicious code on to its pets RFID tag.



## RFID Privacy Issues

### ~ Security Issues

Once the pet is exposed to the Veterinarians reader, the malicious code would enter the database and spread from there. All the pets' data would be erased and the system would finally freeze. The final result would be a message saying, "All your pets belong to us." This is only in a veterinarian's database, what happens when this same type of code infects retail databases or airports RFID-based luggage tracking system. Here is a scenario about a terrorist debilitating a baggage system in order to sneak in a lethal device.

*"A malicious individual could put an infected RFID tag on his suitcase (or someone else's suitcase). The bag will be scanned when approaching a Y-junction, to determine which direction it should go. However the mere act of scanning could infect the airport's baggage database, and as a result, all bags checked in after could receive infected baggage labels. As these bags move to other airports, they would be rescanned -- and within 24 hours, hundreds of airports could be infected worldwide. A smuggler or terrorist using this technique could hide baggage from airline and government officials."*

The consequences that could result from this type of virus spread would be catastrophic to the world. The luggage tracking system is great for making sure bags aren't lost as frequently, but if not protected correctly the above scenario could easily be the result.

## **Conclusion**

The Future holds much promise for many technologies. One is Radio Frequency Identification, which was discussed in this issue. I first talked about the history of this unique way of identifying people and objects. I then talked about the different types of these RFID tags and how they are being used. Last, I discussed the privacy concerns. We are at the point now where RFID chips are beginning to be placed in and on many of the products we come into contact with everyday, but how safe are they? How secure is it to carry your most personal information in a chip that can be read by someone walking past you? How safe is it to use a technology that malicious code can easily be written into and infect your old system within minutes? These important questions are ones that have to be addressed very soon because we are at the brink of either going full force with RFIDs or legislature limiting the possibilities. I am not an advocate for either side; I am simply discussing the issues. RFIDs have already proved to be a technology of the future that is extremely useful. They have the potential to save large amounts of money but more importantly lives. Privacy is the issue here; can RFID technology overcome this hurdle? Only then will RFID reach its full potential.

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